TRANSLATION

I, Tamio Asai, residing at 3, Yatsuka-cho, Soka-shi, Saitama-ken, Japan, state:

that I know well both the Japanese and English languages,

that I translated, from Japanese into English, Japanese Patent Application No. 11-033932, filed on February 12, 1999, and

that the attached English translation is a true and accurate translation to the best of my knowledge and belief.

Dated: November 9, 2004

Tamio Asai

Tamio Asai

PATENT OFFICE
JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application: February 12, 1999

Application Number: Patent Application No. 11-033932

Applicant(s): TOPPAN PRINTING CO., LTD.

This 31st day of August 2001

Commissioner,
Patent Office

Kozo OIKAWA (seal)

Certificate No.2001-3077164

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[Name of Item]	Specification	1
[Name of Item]	Drawing	1
[Name of Item]	Abstract	1

[Document] SPECIFICATION

[Title of the Invention] PLASMA DISPLAY PANEL AND METHOD FOR MANUFACTURING THE SAME

[What is Claimed is:]

[Claim 1]

A plasma display panel comprising a back substrate, wherein barrier ribs and an electrode protective layer are formed of the same barrier rib-forming paste containing a low melting point glass frit, an inorganic filler and a binder.

[Claim 2]

The plasma display panel according to claim 1, wherein a film thickness of said electrode protective layer is in the range of 5 to 50μm.

[Claim 3]

A method of manufacturing a plasma display panel recited in claim 1 or 2, which comprises the steps of transferring a barrier rib-forming paste filled in a barrier ribs-forming intaglio onto a substrate, and heating said barrier rib-forming paste, thereby burning out existing organic components and concurrently sintering said glass frit to thereby form the barrier ribs and electrode protective layer.

[Claim 4]

The method of manufacturing a plasma display panel according to claim 3, wherein the barrier rib-forming paste containing glass frit is filled in the barrier ribs-forming intaglio, an electrode protective layer having a predetermined thickness is concurrently formed on said intaglio, and also the electrode protective layer is transferred onto the substrate.

[Detailed Description of the Invention]

[0001]

[Detailed Description of the Invention]

The present invention relates to a plasma display panel and to a method for manufacturing the same, in particular, to a method for manufacturing barrier ribs for partitioning a discharge region of the plasma display panel, and to the plasma display panel having the barrier ribs manufactured by such a method.

[0002]

[Prior Art]

Conventionally, a CRT has been extensively employed as an image display device. However, the CRT is defective in the respects that it is large in overall size and weight, and that it requires a high voltage, Under the circumstances, a flat type image display device such as a light emitting diode (LED), a liquid crystal display device (LCD), a plasma display panel (PDP), a plasma addressed liquid crystal display (PALC), etc. has been developed in recent years, and these devices are now increasingly utilized.

[0003]

Among them, due to the propagation of multimedia, the PDP which is adapted to be employed as an interface of information in a color display device of large image area is now noticed as promising because the structure thereof where the emission of plasma is utilized is simple, it is suited for achieving a large image area and an excellent image quality, it is light in weight, and it is thin-walled so that it is free from

restriction regarding the installation place thereof.

[0004]

This PDP comprises discharge display cells having minute spaces which are encircled by barrier ribs partitioning a space formed between a pair of flat insulating substrates, wherein each of the discharge display cells is provided therein with a pair of discharge electrodes and an address electrode which is disposed at the bottom of the discharge display cell. The minute spaces of the discharge display cells have an air-tight structure filled therein with a dischargeable gas such as a rare gas, thereby enabling a plasma to be generated in the spaces through the discharging between the discharge electrodes and the address electrode, wherein the switching of light emission of the discharge display cells is effected by the address electrode. The plasma can be generated by selectively applying a voltage between the opposing discharge electrodes, and vacuum ultraviolet rays released from the plasma are utilized for generating light from the phosphors formed within the discharge display cells, thereby making it possible to utilize the discharge display cells as the light-emitting elements of image display device.

[0005]

Therefore, it is required, for the performing the aforementioned switching, to apply a voltage between the discharge electrodes. However, if the electrostatic capacity of the discharge display cell is large, the driving current between the discharge electrodes is rendered to be increased. As a result, the power consumption of the plasma display panel

is required to be increased, thereby raising a problem that the power source equipment of the plasma display panel is required to be enlarged.

[0006]

Further, although the PDP constructed as described above is simple in structure, and suited for enhancing the fineness of image, each of the electrodes and phosphors disposed inside the discharge display cells is permitted to be exposed directly to the plasma being generated. As a result, due to the sputtering effect of the plasma, the surfaces of these electrodes and phosphors are deteriorated, thereby raising a problem that the light emission efficiency of the display panel is liable to be decreased.

[0007]

With a view to overcome these problems, there has been proposed a plasma display panel wherein a dielectric layer is formed on the opposing electrodes disposed inside the discharge display cell to thereby protect the surface of each electrode with this dielectric layer, thereby making it possible to reduce the electrostatic capacity of the discharge display cell and to prevent the electrodes and phosphors from being deteriorated by the plasma generated, thus improving durability of the PDP (Japanese Patent Unexamined Publication H8-77930; and Japanese Patent Unexamined Publication H7-57630).

[0008]

[Objects of the Invention]

As for the method of forming a dielectric layer of uniform thickness on the address electrodes of discharge

display cell, there is generally known a method wherein a dielectric paste is printed, and the uniformity of thickness and the flatness of the printed layer are enabled to be achieved through the leveling effect of the surface of printed paste.

[0009]

However, even if a dielectric paste of low fluidity is employed, with a view to ensure a uniform thickness and flatness of a dielectric layer, for forming a dielectric layer having a thickness of about 5μm on an electrode pattern ordinarily having a thickness of about 10μm, the surface of the dielectric layer to be obtained would become wavy due to the recessed and projected surface constituted by regions where the electrode pattern is existed and regions where the electrode pattern is not existed, thereby making it difficult to obtain a dielectric layer which is uniform in thickness.

[0010]

On the other hand, if a dielectric paste having a high leveling property, i.e. excellent in fluidity is employed with a view to ensure the flatness of dielectric layer, it would become difficult to secure a sufficient thickness of the dielectric layer as it is formed on the address electrode, thereby possibly permitting part of the address electrode to be exposed to the outside. Thus, the thickness of the dielectric layer would become non-uniform, thus making it very difficult to obtain a dielectric layer which is uniform in thickness and excellent in flatness.

[0011]

Therefore, since the thickness or flatness of the dielectric layer formed on the surface of address electrode becomes non-uniform as mentioned above, the quantity of electric charge to be stored in the dielectric layer is caused to differ depending on the regions thereof. As a result, a voltage for controlling the emission of light is caused to differ for each of the discharge display cells depending on the location thereof, thereby raising a problem that it is impossible for the address electrode disposed between the barrier ribs to display a stable and accurate light emission.

[0012]

Furthermore, the forming of the dielectric layer by means of printing method leads to an increase in number of steps by one additional step in the manufacture of the back plate of plasma display panel. Furthermore, since the material for forming the barrier rib differs from the material for forming the dielectric layer, there is a room for improvement not only in terms of productivity but also in terms of material cost.

[0013]

The present invention has been accomplished in view of the aforementioned circumstances, and therefore, an object of the present invention is to provide an electrode protective layer, which can operate at a constant voltage for controlling luminescence of the PDP, can perform a stable luminescence display, has an excellent high resistance to plasma, and is formed of a dielectric layer covered on an address electrode of a discharge display cell and having a constant and optimum thickness and an excellent flatness, and a method of

manufacturing the electrode protective layer for a PDF substrate, which make it possible to easily obtain a large image area of 40 inches or more, to realize an increased fineness of discharge display cell, to obtain a stable and accurate luminescence display, and to enhance the durability of PDF.

[0014]

[Means for Achieving the Objects]

The present inventors have researched in view of the aforementioned circumstances, and found that it is possible to form that portion functioning as an electrode protective layer on the top of the barrier ribs-forming intaglio and the barrier rib from the same material at the same time when barrier ribs-forming material is filled in the intaglio, since that portion of the barrier ribs-forming intaglio for the discharge display cell which is in contact with the back plate on the top of the barrier ribs-forming intaglio corresponds to the electrode-forming portion between the adjacent barrier ribs.

[0015]

That is, the electrode protective layer according to the present invention covers an address electrode arranged on the bottom of a discharge display cell constituted from a back substrate and barrier ribs integrally formed on the back substrate. The electrode protective layer is formed of the same material as that constituting barrier ribs and is formed at the same time when the barrier ribs are formed.

[0016]

Further, the electrode protective layer according to the

present invention has a thickness of 5 to 50μm in order to improve reflectivity, enhance stabilizing of address voltage, and prevent drawbacks such as sprits and cracks.

[0017]

The method of manufacturing a electrode protective layer according to the present invention is characterized by comprising filling a barrier rib-forming material, which can also form an electrode protective layer, in a barrier ribs-forming intaglio, positioning the barrier ribs-forming intaglio so that the electrode protective layer covers an electrode pattern, bringing the barrier ribs-forming intaglio into in contact with a back substrate using an adhesive etc., transferring the electrode protective layer onto the back substrate at the same time as forming of the barrier rib, and heating the electrode protective layer and the barrier rib.

[0018]

The invention recited in claim 1 provides a plasma display panel comprising a back substrate, wherein barrier ribs and an electrode protective layer are formed of the same barrier rib-forming paste containing a low melting point glass frit, an inorganic filler and a binder.

[0019]

The invention recited in claim 2 provides the plasma display panel according to claim 1, wherein a film thickness of said electrode protective layer is in the range of 5 to 50μm.

[0020]

The invention recited in claim 3 provides the method of manufacturing a plasma display panel recited in claim 1 or 2,

which comprises the steps of transferring a barrier rib-forming paste filled in a barrier ribs-forming intaglio onto a substrate, and heating said barrier rib-forming paste, thereby burning out existing organic components and concurrently sintering said glass frit to thereby form the barrier ribs and electrode protective layer.

[0021]

The invention recited in claim 4 provides the method of manufacturing a plasma display panel according to claim 3, wherein the barrier rib-forming paste containing glass frit is filled in the barrier ribs-forming intaglio, an electrode protective layer having a predetermined thickness is concurrently formed on said intaglio, and also the electrode protective layer is transferred onto the substrate.

[0022]

<Function>

According to the electrode protective layer of the present invention and the method of manufacturing the same, since the electrode protective layer formed of a dielectric material and arranged on the bottom of the discharge display cell surrounded by the barrier rib integrated with the back substrate thereon constituting the PDP substrate has a constant and optimum thickness, the amount of electric charge in the dielectric material constituting the electrode protective layer is uniformed, and voltage for emission control in each discharge display cell becomes equal and thus obtaining the stable precise emission display.

[0023]

Further, since dielectric material for forming the electrode protective layer is same as that for forming the barrier rib and the electrode protective layer can be formed at the same time as forming of the barrier rib, producibility can be improved and cost can be reduced in the manufacturing process of the PDP substrate.

[0024]

[Embodiment of the Invention]

There will now be described the electrode protective layer and the method for manufacturing the same with reference to the drawings as follows.

[0025]

Barrier rib-forming intaglio 11 has a reversed configuration of barrier ribs. As for the barrier rib-forming intaglio 11, a metal intaglio or a resin intaglio can be employed, and the configuration thereof may be of a cylindrical plate or a flattened plate (FIG.1). As a typical example of the metal intaglio, a copper plate engraved or etched, i.e. such as those employed in the intaglio printing can be employed. As for the resin intaglio, it can be manufactured by a method where a resin is filled in a metallic letterpress constituting a matrix of intaglio, and then, the copy thereof is taken up as an intaglio, or by a method where a photosensitive resin is cured through a photomask, and the resultant cured resin is subjected to a development process to thereby form an intaglio.

[0026]

Barrier rib-forming material 12 is filled in the barrier

rib-forming intaglio 11 to thereby allowing electrode protective layer 13 to be produced concurrently (FIG.2). More specifically, barrier rib-forming material 12 is filled in the groove of barrier rib-forming intaglio 11, and at the same time, a layer having an uniform thickness is allowed to be formed on the intaglio. As a result, the electrode protective layer 13 can be formed on the top of the barrier rib-forming intaglio 11.

[0027]

If the thickness of the electrode protective layer 13 is too thin, the electrodes may be exposed, thereby making the electrode protective layer 13 ineffective. On the other hand, if the thickness of the electrode protective layer 13 is too thick, it will invite the generation of splits or cracks on the occasion of sintering the substrate.

[0028]

The barrier ribs 17 and electrode protective layer 13 should preferably be white in color and excellent in reflectance so as to enable the luminescence of phosphor to be reflected to thereby improve the brightness. Therefore, a white pigment such as TiO2, ZrO2, Al2O3, etc. can be added to the barrier rib-forming material 12. In this case, the ratio of a white pigment to a low melting point glass is generally in the range of 3 to 30% in view of maintaining the configuration of the barrier ribs 17 in the sintering step as well as in view of density of the barrier ribs 17. If it is desired to employ the barrier rib-forming material 12 as a protective layer 13 of electrode, the thickness of the electrode protective layer 13

is required to be 5μm or more in order to obtain a sufficient reflectance. On the other hand, if the thickness of the electrode protective layer 13 is 50μm or more, it will invite an increase of address voltage or it may become difficult to perform accurate address, and hence it is undesirable. Due to these reasons, the thickness of the electrode protective layer 13 should preferably be in the range of 5 to 50μm.

[0029]

As for the barrier rib-forming material 12 to be charged into the barrier rib-forming intaglio 11, the employment of a paste having an excellent fluidity is preferable for the purpose of filling the intaglio. As for the type of curing, it may be selected from an evaporation curing type, a heat curing type, a two-part curing type, and an ionizing radiation curing type such as ultraviolet rays, electron beam, X-rays, etc. Therefore, the barrier rib-forming material comprises an inorganic powder which is capable of sintering through sintering, and an organic component for giving a fluidity to the paste and for retaining the configuration of barrier rib after the curing thereof.

[0030]

As for the inorganic component, it is possible to employ the powder of a low melting point glass represented by PbO-B2O3-SiO2, to which a white pigment such as Al2O3, TiO2, ZrO2, etc. may be added. However, for the purpose of adjusting the color tone of the barrier ribs, any desired pigments may be added to the glass powder.

[0031]

As for the organic component, though it may differ depending on the cured state, a material which is capable of removing a binder therefrom at a temperature of not higher than the glass softening temperature thereof is preferable. In the case of the evaporation curing type for example, a solution of resin wherein a general-purpose natural resin, a semi-synthetic resin or a synthetic resin is dissolved in a solvent can be employed. In the cases of the heat curable type, the two-part curing type and the ionizing radiation curing type, a cured state of paste can be achieved by combining a reactive resin or a reactive monomer with a polymerization initiator. Two of more kinds of these cured types can be combined together.

[0032]

After the barrier rib-forming material 12 is filled in the barrier rib-forming intaglio 11, the positioning of the glass substrate 104 having an electrode pattern 15 deposited thereon in advance is performed (FIG. 3), and then, the barrier rib-forming material 12 is transferred to the surface of the glass substrate 14. In this case, any of the following methods can be selected, i.e. a method wherein the barrier rib-forming material 12 is allowed to cure before the barrier rib-forming material 12 is transferred onto the glass substrate 14; and a method wherein the barrier rib-forming material 12 is allowed to contact with the glass substrate 14 before the barrier rib-forming material 12 is still in an uncured state, and under this condition, the barrier rib-forming material 12 is allowed to cure. Any of these methods can be selected. In the case of the former transfer method, an adhesive or a self-adhesive 16

is required to be interposed between the barrier rib-forming material 12 and the glass substrate 14 (FIG. 4). In the case of the latter transfer method however, since the barrier rib-forming material 12 is allowed to cure on the glass substrate 14, the adhesive or the self-adhesive 16 is no longer required to be employed. However, the adhesive or the self-adhesive 16 may be employed for the purpose of enhancing the mechanical strength of the barrier ribs.

[0033]

Thereafter, the glass substrate 14 transferred to the barrier ribs 17 is baked to vanish organic components (FIG.5) and to sinter the glass components. As a result, the back plate of plasma display panel, which is provided with inorganic barrier ribs 17 and the electrode protective layer 13 can be obtained (FIG. 6).

[0034]

As explained above, according to the present invention, the back plate of plasma display panel can be manufactured by making use of a method wherein the electrode protective layer 13 and the barrier ribs 17 are both formed of the same material.

[0035]

[Example]

Next, specific examples of the present invention will be explained.

[0036]

Incidentally, it should be noted that the following examples are not intended to limit the scope of the present

invention.

[0037]

<Example 1>

Barrier rib-forming intaglio

The type of intaglio: Flat type resin intaglio made of polyethylene;

The configuration of grooves: Stripe-shaped, 30μm in width, 200μm in depth and 140μm in pitch.

[0038]

Barrier rib-forming material

PbO-B2O3-SiO2 type low melting point glass powder: 62 parts by weight

Al2O3: 12 parts by weight

TiO2: 8 parts by weight

Diethylene glycol dimethacrylate 10 parts by weight

2-hydroxyproply acrylate 7 parts by weight

Benzophenone 1 part by weight

The above composition was obtained by fully kneading the following composition by making use of a roll mill.

[0039]

The barrier rib-forming material thus obtained was filled, by means of roll press, in a polystyrene flat intaglio having recessed portions, i.e. reversed in configuration of the barrier ribs, thereby simultaneously forming the portion of barrier ribs and the portion of electrode protective layer. Then, ultra-violet rays were irradiated onto this barrier rib-forming material under the condition of 2000mJ/cm2. Then, the

intaglio filled with the barrier rib-forming material was placed on and aligned with a glass substrate coated, all over the surface thereof, with acrylic self-adhesive 5μm in thickness, and then, a flat press was performed onto the resultant composite body with a pressure of 5 Kgf/cm2. Thereafter, the intaglio was released from the substrate and baked for 30 minutes at a temperature of 580℃ to thereby obtain a back plate provided with a electrode protective layer having a uniform thickness of 10μm.

[0040]

<Example 2>

Barrier rib-forming intaglio

The type of intaglio: Flat type resin intaglio made of silicone rubber;

The configuration of grooves: Stripe-shaped, 30μm in width, 200μm in depth and 140μm in pitch.

[0041]

Barrier rib-forming material

PbO- B2O3-SiO2 type low melting point glass powder:	62 parts by weight
Al2O3:	12 parts by weight
TiO2:	8 parts by weight
Diethylene glycol dimethacrylate	10 parts by weight
2-hydroxyproply acrylate	7 parts by weight
Benzophenone	1 part by weight

The above composition was obtained by fully kneading the following composition by making use of a roll mill.

[0042]

The barrier rib-forming material thus obtained was filled, by means of doctor blade, in a silicone rubber flat intaglio having recessed portions, i.e. reversed in configuration of the barrier ribs, thereby simultaneously forming the portion of barrier ribs and the portion of electrode protective layer. Then, ultra-violet rays were irradiated onto this barrier rib-forming material under the condition of 2000mJ/cm2. Then, the intaglio filled with the barrier rib-forming material was placed on and aligned with a glass substrate coated, all over the surface thereof, with acrylic self-adhesive 5μm in thickness, and then, a flat press was performed onto the resultant composite body with a pressure of 5 Kgf/cm2. Thereafter, the intaglio was released from the substrate and baked for 30 minutes at a temperature of 580℃ to thereby obtain a back plate provided with a electrode protective layer having a uniform thickness of 10μm.

[0043]

[Advantage of the Invention]

According to the method for manufacturing the barrier rib and the electrode protective layer according to the present invention, since the barrier rib and the electrode protective layer can be formed at the same time, the manufacturing process is simple and the back plate for PDP can be provided with a low cost.

[0044]

[Brief Description of Drawings]

[FIG. 1]

One example of the barrier rib-forming intaglio.

[FIG. 2]

One example illustrating a state wherein a barrier rib-forming material is filled in the barrier rib-forming intaglio

[FIG. 3]

One example illustrating illustrating a state of alignment between a glass substrate bearing thereon an electrode pattern and the barrier rib-forming intaglio filled with a barrier rib-forming material.

[FIG. 4]

One example illustrating a transferring step where an adhesive or a self-adhesive is employed.

[FIG. 5]

One example illustrating a state where the barrier rib-forming intaglio is peeled away.

[FIG. 6]

One example illustrating a back plate after the sintering thereof.

[Description of the Symbol]

11 barrier rib-forming intaglio

12 barrier rib-forming material

13 electrode protective layer

14 glass substrate

15 electrode

16 adhesive or self-adhesive

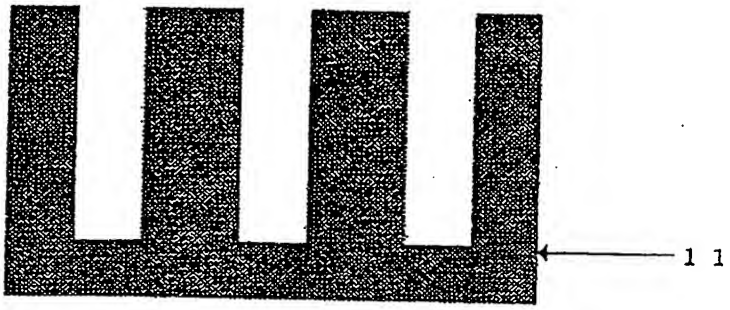
17 barrier rib

NAME OF DOCUMENT

【書類名】　図面　DRAWINGS

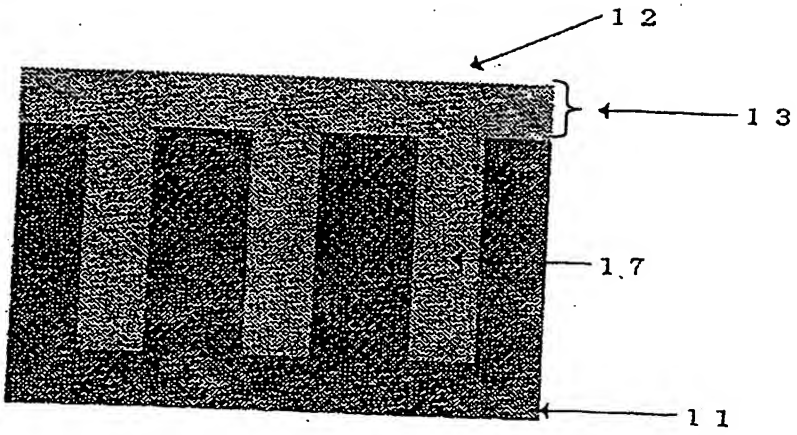
【図１】

FIG. 1



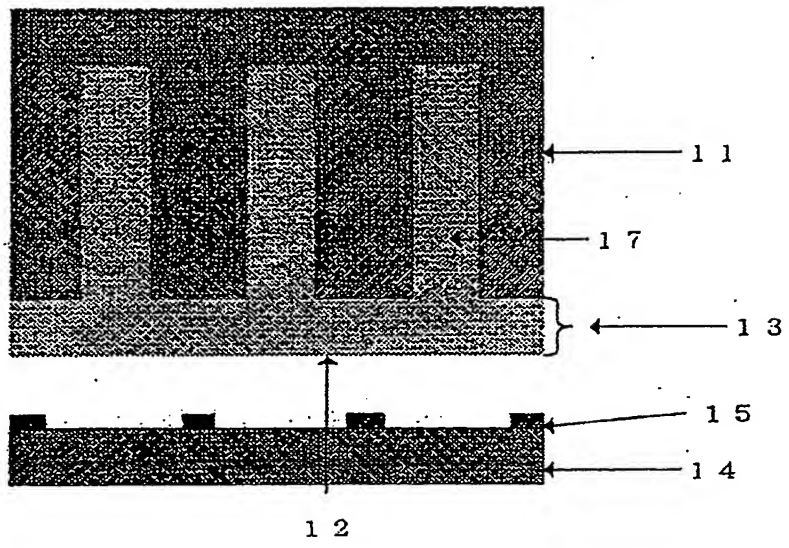
【図２】

FIG. 2



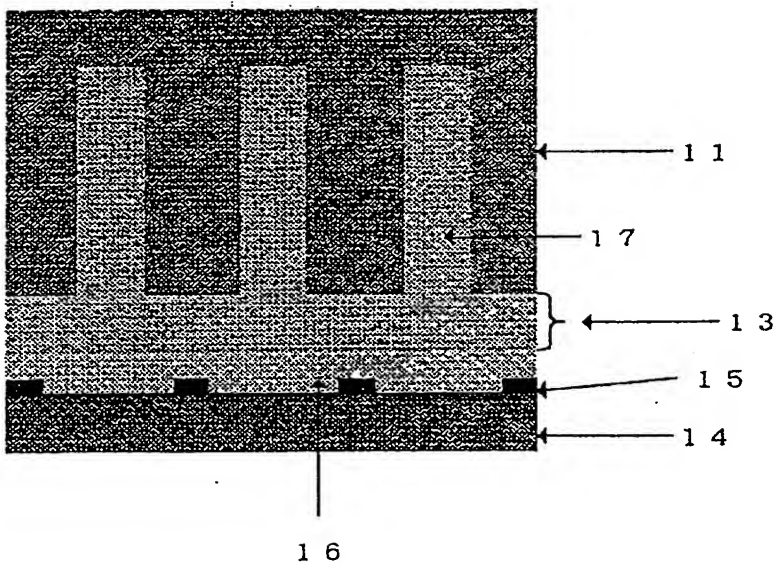
【図３】

FIG. 3



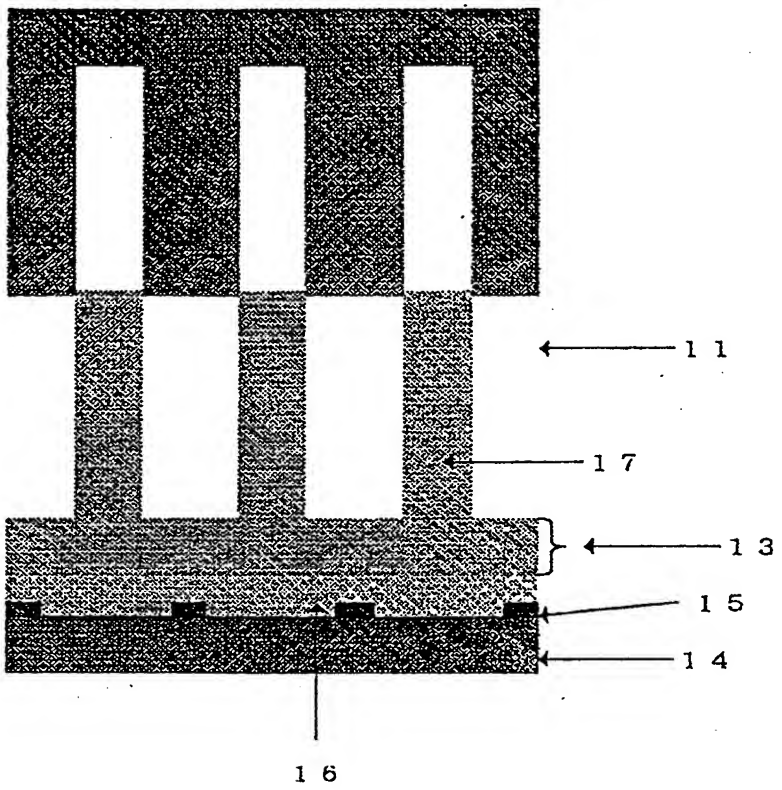
【図４】

FIG. 4



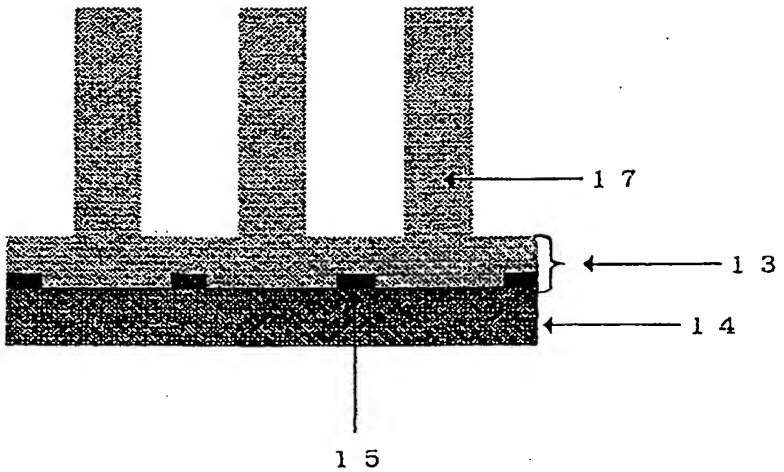
【図５】

FIG. 5



【図６】

FIG. 6



[Document] ABSTRACT

[ABSTRACT]

[Object] To provide a an electrode protective layer, which can operate at a constant voltage for controlling luminescence of the PDP, can display a stable luminescence, has an excellent high resistance to plasma, and is formed of a dielectric layer covered on an address electrode of a discharge display cell and having a constant and optimum thickness and an excellent flatness, and a method of manufacturing an electrode protective layer for a PDF substrate, which make it possible to easily obtain a large image area of 40 inches or more, to realize an increased fineness of discharge display cell, to obtain a stable and accurate luminescence display, and to enhance the durability of PDF.

[Means for achieving the Problem] An electrode protective layer for a PDF substrate which covers an address electrode arranged on the bottom of a discharge display cell constituted from a back substrate and barrier ribs integrally formed on the back substrate, and is formed of the same material as that constituting barrier ribs and is formed at the same time when the barrier ribs are formed.

[Elected Figure] FIG.3

APPLICANT'S PAST DATA

Identification Number [000003193]

1. Date of Change August 24, 1990

[Reason for Change] New Registration

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